External Independent Peer Review by the Center for Independent Experts

Evaluation of excessive shares study in the Mid-Atlantic surfclam and ocean quahog ITQ fishery

Prepared by

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Acronyms

NFMS	National Marine Fisheries Service
MAFMC	Mid-Atlantic Fishery Management Council
SCOQ	Surfclam and ocean quahog
CIE	Center for Independent Experts
ITQ	Individual transferable quotas
TAC	Total allowable catch
SOW	Statement of Work*
TOR	Terms of reference
HH	Herfindahl-Hirchman index
HMG	Horizontal merger guidelines

Executive Summary

1. The surfclam and ocean quahog (SCOQ) fishery was subjected to ITQs (individual transferable quotas) in 1988. Since then industrial concentration in the fishery has increased substantially [Chapter 3, p. 7]

2. In competition theory, market power is defined as the ability of companies to profitably manipulate output (or input) prices. This activity, while profitable for the companies, usually corresponds to an overall economic loss for society. [Chapter 3, p. 8]

3. Increased concentration in ITQ fisheries is a matter of social concern. Accumulation of quota-share holdings may provide companies with market power and enable them to influence prices in input and output markets. [Chapter 1, p. 5]

4. The Magnuson-Stevens Act states that ITQ privilege programs should ensure that limited access privilege holders do not acquire an excessive share of the total limited access privileges in the program. The National Standard 4 of the Magnuson Act imposes a similar requirement. [Chapter 1, p. 5]

5. Measures of industrial concentration in the SCOQ fishery (the Herfindahl-Hirchman index) suggests that marketing power may exist in the fishery, particularly in its harvesting and processing sectors, but less so in quota holdings. [Chapter 3, pp.7-8]

6. These concentration measures are only indicative of the possibility of market power. They do not establish that it actually exists. In fact, the report by the NMFS Technical Group does not provide evidence of actual market power in the SCOQ fishery. [Chapter 3, pp. 8-9]

7. It should be noted that even when market power exists it may not be exercised for a number of reasons. In fact, the report by the NMFS Technical Group does not find any evidence of the actual exercise of market power in the SCOQ fishery [Chapter 3, p. 8]

8. Due to the inherent complexity of ITQ fisheries, the determination of market power is more complicated than in more standard industries. It follows that to determine "excessive shares" in the sense of generating market power requires deeper analysis and more complicated expressions [Chapter 3, pp. 8-10, Addendum 2.]

9. In an ITQ fishery the main tool for manipulating prices and, thus, exercising market power is to withhold quotas from fishing. Quotas may be held by fishers, fish processors, quota-holders which are neither and any combination of the three. Clearly the commercial interests of these types of players are not identical and, in some respects, they may be contrary. It follows that the distribution of quota holdings or quota control among these three types of players in the fishery is a major factor in the possible exercise of market power. [Chapter 3, pp. 9-10]

10. A limited theoretical analysis to account for some of the complex aspects of market power and monopolistic behavior in ITQ fisheries suggests that what constitutes excessive shares (in the sense of generating market power) is a function of a number of empirical variables in the fishery including various elasticities, the market price of quota, the output price of fish and other variables. In a comparatively simple framework this function may be expressed as:

$$\alpha_{crit} = \Lambda(E(p,H), E(w,H), E(s,H), s/p, \beta),$$

where α_{crit} is the critical share of the company before it becomes excessive. The first three terms of the function Λ denote the elasticities of output price, input price and

quota price with respect to harvest. s represents the market price of quota and p the price of landed catch. Finally, β is the ratio of costs to revenues for the company.

Obviously, to determine "excessive share" in a sensible manner requires an empirical estimate of all of the variables entering the function Λ. More realistic situations will undoubtedly involve more variables [Chapter 3, pp. 9-10 and Addendum 2]

11. The fundamental economic justification for controlling market power and, more generally, curtailing monopolistic behavior is to avoid the "deadweight loss of monopolies" which is the economic cost resulting from altering quantities to influence prices. [Chapter 3, p. 10 and Addendum 1]

12. However, in order to form a socially beneficial policy regarding market power, this cost must be balanced against (i) the possible gains in economic efficiency due to scale economies that may be captured by large companies and (ii) the cost of implementing and enforcing the regulations to curtail market power. [Chapter 3, p. 11]

13. Limitations of company share of quotas or relative size in general are a particularly blunt tool to curtail the exercise of market power. It may well be preferable to ignore company size but focus instead on methods to counteract monopolistic behavior more directly. [Chapter 3, p 11. and Addendum 1]

14. As a procedure to determine "excessive share" limits in the SCOQ fishery, the method proposed by the Technical Group is unsatisfactory. Among other things:

    (1) It does not go into sufficient depth in analyzing this particular industry and the role of ITQs in possible monopolistic behavior by the companies.

    (2) It offers little data about the structure of the industry and the operations of the key markets and virtually none on the relationships that determine what constitutes an "excessive share".

    (3) It totally ignores certain key aspects of the economic situation such as the cost of possible monopolistic behavior, the possible benefits of returns to scale and the cost of imposing and operating "excessive share" limits.

    As a result, the recommended "excessive share cap" for the SCOQ fishery has little if any foundation in either solid theory or empirical data. [Chapter 3, pp.13-14]

15. My conclusion is that the evidence provided in the Technical Group report is insufficient to set any particular share cap on the companies in this fishery. Given the possible costs of an erroneous cap, the prudent course of action seems to be to set no cap at the current time. [Chapter 3, p. 14]

16. It is further my conclusion that the approach outlined in the Technical Group Report, although a helpful step in the right direction, is inadequate as a general framework for setting excessive share limits in fisheries in general. [Chapter 3, p. 14]

17. Given the high economic value of fisheries already under ITQs in the US, the legal requirement to set excessive share limits and the potential economic costs of setting such shares inappropriately, it is urgent to develop a theoretically consistent and empirically robust procedure to assess what constitutes "excessive share". It is strongly recommended that concerted research and development work of this nature be initiated as soon as possible. [Chapter 3, p. 15]

1. Background

On May 12, 2011, I agreed to serve, on behalf of the Center for Independent Experts (CIE), as an independent external reviewer of the "Evaluation of excessive shares study in the Mid-Atlantic surfclam and ocean quahog ITQ fishery" that had been prepared for the National Marine Fisheries Service (NMFS) and the Mid-Atlantic Fishery Management Council (MAFMC) by a Technical Group of Experts.

The surfclam and ocean quahog (SCOQ) fishery was subjected to an ITQ (individual transferable quota) system in 1988. Under the ITQ system, economic efficiency of the fishery seems to have improved substantially (Mitchell et al. 2011, MAFMC and NMFS 2010). Presumably related to this, industrial concentration in the fishery has increased, especially when measured by the number and size distribution of active companies and fishing vessels (Mitchell et al. 2011, MAFMC and NMFS 2010). Apparently there has also been some, although smaller, increase in the concentration in quota holdings but the extent of this is less clear (Mitchell et al. 2011, Social Sciences Branch 2009).

Increased concentration in ITQ fisheries is a matter of social concern. Accumulation of quota-share holdings may provide companies with market power and enable them to influence prices in input and output markets. The reauthorized Magnuson-Stevens Act (2006) states that ITQ privilege programs should ensure that limited access privilege holders do not acquire an excessive share of the total limited access privileges in the program. The National Standard 4 of the Magnuson Act requires that fishing privilege allocations be carried out so that "no particular individual, corporation, or other entity acquires an excessive share of such privileges" (SOW, appendix 2). It is, however, not clear what constitutes an "excessive share" in this context.

To deal with the issue of "excessive share", a Technical Group of Experts (referred to in the TOR as the NMFS Technical Group) was created. This technical Group, whose membership was provided by the consultancy company Compass Lexecon, submitted a report titled "Recommendations for Excessive-Share Limits in the Surfclam and Ocean Quahog Fisheries" (Mitchell et al. 2011). This report (i) outlines a procedure for determining an "excessive share" in any fishery and (ii) suggests an excess share limit for the SCOQ fishery.

Given this context, I was specifically requested to address the following issues:

1. Describe the method or process used by the NMFS Technical Group for determining the maximum possible allowable percentage share of quota ownership that will prevent an entity from obtaining market power.
2. Evaluate the strengths and weaknesses of the proposed method developed by the NMFS Technical group for determining maximum possible allowable percentage share of quota ownership. Review and comment on the data requirements necessary for applying the proposed methods.
3. Evaluate application of the proposed methods to the Surfclam/Ocean Quahog ITQ fishery. If there is disagreement with what the NMFS Technical Group recommended, clearly state that and your reason why.

4. Evaluate whether the approach outlined by the NMFS Technical group is reasonable for setting excessive share limits in fisheries managed through catch shares? As part of this TOR, comment on any constraints that may hinder application of the methods proposed by the NMFS Technical group.
5. Provide any recommendations for further improvement

Further details of my obligations under this contract are set out in the Statement of Work a copy of which is found in Appendix 2 of this report.

My work on this review was primarily carried out during the period June 15 to July 7 2011. The first part of the period was used to collect background information and study the material on this issue provided by the CIE. A Panel Review meeting took place in Falmouth and Woods Hole on June 21-23. The period after that was used to assess the information and findings at this meeting to undertake further analysis of the issues and to prepare this report.

2. Description of Reviewer's role in Review Activities

The review work was for the most part carried out during the period June 15 to July 7, 2011. It is primarily based on (i) two reports supplied to me by the CIE (Mitchell et al. 2011 and MAFMC and NMFS 2010, see bibliography), (ii) a number of background articles and reports that I located (see bibliography),(iii) the background presentation given by the MAFMC representative (vice chairman Lee Anderson)and the presentation given by Technical Group representatives (S. Peterson and G. Mitchell) at the Peer Review Meeting on June 21-23 and questions and discussions during that meeting, (iv) further information about the SCOQ fishery provided by the staff at the Northeast Fisheries Science Center (especially J. Walden) and (v) my own general knowledge on the subject. Much of the written material used in this review is listed in the bibliography.

During the Peer Review Meeting June 21-23, I had the opportunity to ask questions for clarification and discuss the various aspects of the report by the Technical Group and the competitive situation in general. During that meeting I received honest and clear answers to all my questions. The general discussion was also, in my opinion, extremely informative and useful to all participants.

During the Peer Review Meeting I inevitably became privy to views and comments made by my fellow reviewers. This report, however, contains exclusively my own assessments and evaluations.

In further detail my review activities proceeded as follows:

- June 15-20. Collect and study background material including the documentation supplied by the CIE.
- June 20-June 24. Travel to and attend the panel meeting at NEFSC in Woods Hole.
- June 25-July 7. Study of material, further analysis and the preparation of my draft review report.

3. Summary of findings

The Surf Clam and Ocean Quahog (SCOQ) fishery off the Atlantic coast of the US has a considerable history going back to at least to the 1960s (FAO 2011). This is not a particularly large fishery. In recent years the harvest in federal waters has been just over 6 million bushels (MAFMC and NMFS 2010) with an approximate landed value of between $50 and 60 million.[1] Landings have been quite stable over time and so, apparently, have unit prices of landings.

From the 1970s until 1988, this fishery was regulated by a number of technical measures including restrictions on vessel entry, fishing effort, seasons and fishing gear (Adelaja et al. 1998, MAFMC and NMFS 2010). These policies led to an increasingly over-capitalized and inefficient fishery (Marvin, 1992; Adelaja et al. 1998). Following amendment 8 to the Fishery Management Plan for this fishery set by the MAFMC in 1988, the SCOQ fishery was subjected to an ITQ system leading to a substantially improved economic efficiency (MAFMC and NFMS 2010).

Concentration

Since the adoption of the ITQ system in 1988, there has been substantially increased concentration in the fishery with respect to the number of active fishing vessels and the number of processing companies. There also seems to have been certain concentration in quota ownership although, apparently, to a lesser degree (Social Science Branch 2009, Mitchell et al. 2011).

The current level of concentration in the industry is to a certain extent measured by the so-called Herfindahl-Hirchmann (HH) index (Hirchman 1945, Herfindahl 1950).[2] According to the Technical Group Report (Mitchell et al 2011), the number of processing plants has been reduced from 44 in 1979 to 12 in 2011. In terms of purchases the HH-index for surfclams grew from 2068 in 2003 to 3134 in 2008 and that for ocean quahogs from 3431 to 4369 (Mitchell et al. 2011). Similar statistics for the development of concentration in quota-holdings and harvesting are not available. However, in 2009, the combined (both species) HH-index for quota holdings was 993 and for the harvesting activity 2890 (Mitchell et al. 2011).

These values of the HH index may be compared to the thresholds defined in the US government Horizontal Merger Guidelines (anonymous 2010) according to which industries with an HH index below 1500 are considered unconcentrated and those with an HH index value above 2500 highly concentrated.

Market power

In competition theory, market power refers to the ability of companies to profitably manipulate output (or input) prices. More formally, market power may be defined to exist

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1 This estimate assumes a landings price of $12 for a bushel of surfclams and $6 for a bushel of ocean quahog.

2 The HH-index is just one of many possible single-number-measures of concentration. As all single-number-measures of complicated phenomena, this measure suffers from severe limitations one of which is the lack of uniqueness, i.e. the same index number generally corresponds to many different combinations of company sizes and number. It is worth noting that as pointed out by Hirchman (1964), his initial definition and use of this index preceded that of Herfindahl by five years.

when a firm (or a group of firms, acting jointly) are able to raise output price above the competitive level without losing sufficient sales to make the price increase unprofitable (Landes and Posner 1981, Tirole 1989). Given this definition, some degree of market concentration is obviously necessary to provide market power to one or more companies. It is, however, not by any means sufficient. To see this, one only has to note that a single company (therefore having an HH-index of 10000) operating in a market with perfectly elastic supply and demand curves has no market power.

According to the concentration thresholds set by the Horizontal Merger Guidelines mentioned above, there are indications of market power in the harvesting and processing activity but much less so for quota holdings. It should be stressed, however, that due to the imperfectness of the HH-index and the gap between HH-concentration measures and market power, these are only indications of possible market power. The HH-index measures obtained by no means establish that there actually exists market power in these sectors of the SCOQ fishing industry. By the same token, the low HH-index measure of quota holdings can not be taken to show that there is no market power in this sector of the SCOQ fishery. Indeed, there are indications that the real control of quotas may well be more concentrated than the formal ownership.

Exercise of market power

It is important to realize that the existence of market power (in the sense defined above) does not imply that it will be exercised. There can be several reasons for this including the following:

(1) The company having market power does not realize this and acts as if it had none.
(2) The company simply prefers to accept normal (rather than monopoly) profits possibly for reasons of maintaining its reputation or because of perceived social responsibility.
(3) The company is deterred by the illegality of and possible sanctions for exercising market power.
(4) The exercise of market power requires co-ordination with other companies which is too difficult (or costly) to arrange and maintain.

It follows that even if it can be shown that market power exists, it has not been established that this power is actually being exercised.

Market power in an ITQ fishery

Due to the complexity of ITQ fisheries (caused by the quota constraint, quota trading and the inherently dynamic nature of the fishery and quota holdings), the determination of market power in an ITQ fishery is much more involved than for standard (textbook) industries. It follows that the relevant relationships must be carefully analyzed and examined in order to determine the existence of market power. Certain aspects of possibly major importance are listed below:

(1) In an ITQ fishery, to the effect that monopolistic behavior depends on constraining quantity, market power resides largely with quota holders. Quota use determines catches and subsequent outputs in the production chain. All other quantities entering

the production chain depend functionally (via production functions) on the volume of catches with, generally, relatively little scope for substitutions.

(2) The ITQ system alters opportunities for monopolistic behavior in fisheries in two somewhat opposite ways:

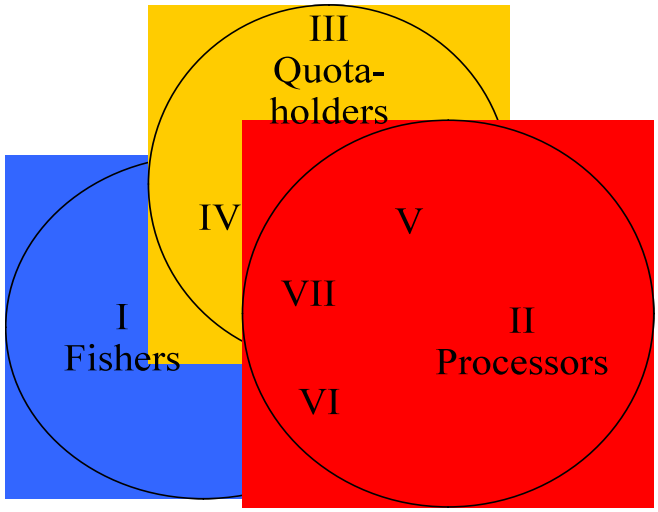
(i) The imposition of an upper level quantity constraint (the TAC) reduces the scope for quantity adjustments in the fishery (and downstream activities). In fact, the TAC may easily be less than the monopoly point for the companies.

(ii) The system erects certain barriers to entry into the fishery — newcomers need to buy quotas to become active in the fishery. This barrier is similar or the situation in the retail business where the competitors control the available sites for setting up business.

(3) It follows from the previous two points that in an ITQ fishery the main instrument for exercising market power is to withhold quotas from being fished. This does not mean of course that there are no opportunities for other types of monopolistic activity. The point is simply that in an ITQ fishery, this is the most important quantity for monopolistic manipulation and, moreover, the one that is made available to the companies by the establishment of the ITQ system.

(4) As in any other situation of possible monopolistic behavior, the structure of the industry is of major importance. In the SCOQ fishery, the main players appear to be (i) quota holders, (ii) fishing companies and (iii) processing companies. Further, processors and wholesale distributers may also play a role but that is ignored here. Some companies may be involved as one or more of these basic players. The combination possibilities are summarized in the following figure

Figure 1
Main fishery players and their possible configuration



As shown in the figure, there can be various types of companies in this industry. These include (i) pure quota-holders, (ii) pure fishermen and (iii) pure processors. But there can also be any combination of these three. All in all there are seven possible

configurations of companies. From the data supplied (MAFMC and NMFS 2010 and Mitchell et al. 2011) as well as other information (see Appendix 1), it appears that most or all of the possible configurations actually exist in the fishery.

It can be shown that the possible monopolistic profit maximizing behavior differs in general from one configuration of companies to the other.[3] It immediately follows that the appropriate policy response depends on the type of company in question and, consequently, on the overall configuration of companies in the industry.

A limited attempt to account for some of these aspects of an ITQ fishery in the analysis of market power points is presented in an Addendum 2 to this report. This analysis, limited as it is, suggests that in an ITQ fishery market power and monopolistic behavior on that basis is quite complex. A basic condition for the existence of market power derived in Addendum 2 is:

(1) $$\boxed{\alpha(i) > \frac{1}{1 + E(s,H) + \left(\beta(i) \cdot E(w,H) - E(p,H)\right) \cdot \frac{p}{s}}}$$

This expression gives the relative size of company i (share of fishery or quotas) denoted by $\alpha(i)$, that is necessary for market power. This may be referred to as the critical size. On the right-hand side of the inequality; p/s is the output price to quota price ratio, $\beta(i)$ is the cost to revenue ratio of the company and $E(s,H)$, $E(w,H)$, $E(p,H)$ are the respective elasticities of quota price, input prices and output price with respect to total harvest volume. Needless to say, this expression accounts for market power in the output market, input market (monopsony) and the market for quotas.

From expression (1), we immediately derive a set of important conclusions of general validity:

(1) The determination of the critical company size (before market power is gained) is a complicated matter involving a number of variables.

(2) It immediately follows that an extensive empirical investigation is needed before the appropriate size limit is determined.

(3) A limited analysis considering e.g. only the market power in the output market and the elasticity of price w.r.t. harvests is inadequate in the sense that it can easily lead to erroneous conclusions. (Note for instance that the $E(s,H)$ works in an opposite way to the other elasticities) .

(4) For seemingly reasonable values of the variables on the right-hand-side of (1), the critical relative size of a company (before market power is gained) appears to be quite substantial. This is discussed at some length in Addendum 2.[4]

[3] This is touched upon but not really explored in Addendum 2.

[4] In Addendum 2, based on reasonable guestimates of the values of the arguments in (1), was calculated to be about 83%.

Controlling market power

The fundamental economic justification for controlling market power and, generally, curtailing monopolistic behavior is to avoid the economic "deadweight loss of monopolies" (Varian 1984, Tirole 1989. See Addendum 1). However, it must be realized that there may be costs involved. The most obvious ones are:

(1) Losses in the efficiency of the economic activity in question
(2) Costs of imposing and enforcing the controls on market power.

Clearly, for sensible policy, these costs have to be balanced against the potential gains from reducing the "deadweight loss" of monopolistic behavior.

There are many ways to control or counteract market power (Tirole 1989). The method under consideration in this study is to set an upper limit on the share of quotas, the so-called "excessive share" limit that may be held (or controlled) by any one entity. This corresponds to a limitation on company size.

It should be noted that the "excessive size" limit is an extremely imprecise tool. It may for instance hit companies that have not exercised market power or it may be bypassed by co-ordination between companies. A superior method, although much more complicated to implement, is not to restrict company size but to counteract monopolistic behavior directly (see Addendum 1 to this report).

It is important to realize that relatively large companies are often the result of economic returns to scale. In other words, relatively large companies are simply economically more efficient than smaller companies. This often applies in fisheries, especially comparatively small ones as the SCOQ fishery. It follows that limiting the size of companies in such fisheries may forgo the social gains that can be had by reaping the economic benefits of returns to scale. This is discussed in Addendum 1 to this report, where it is shown that the loss in efficiency due to a size limit on companies can easily outweigh the gains from reduced market power.

Imposing and enforcing constraints on monopolistic behavior is inevitably costly. In some cases this cost can be very high. Additional costs are borne by companies which, inevitably try to find ways to adjust to and even circumvent any binding restrictions. These costs must also be set against the potential gains of less monopolistic behavior.

Responses to the specific items in the TOR

1. *Describe the method or process used by the NMFS Technical Group for determining the maximum possible allowable percentage share of quota ownership that will prevent an entity from obtaining market power*

   The technical group (Mitchell et al. 2011) applies the standard theory of competition and market power to the problem. The method is in accordance with the procedure suggested in the US government *Horizontal Merger Guidelines* (anonymous 2010). This is to a certain, but limited, extent complemented by an interpretation of some aspects attributed to the ITQ system in the SCOQ fishery.

In essence the method applied to the SCOQ fishery specifically is as follows:

(1) The HH-index is applied to measure concentration in the various sectors of the industry. The Technical Group finds a rather low concentration of quota ownership, but high concentration of quota use (harvesting) and in processing.

(2) The HH-index outcomes are compared with the thresholds in the *Horizontal Merger Guidelines* (anonymous 2010) apparently suggesting that sectors exceeding these thresholds warrant particular consideration.

(3) Certain factors that limit market power (e.g. elasticities) are identified and their values speculated about. On this basis, apparently, the Technical Group is particularly concerned about output markets (monopoly) but pays comparatively little attention to input markets (monoposony).

(4) The industry structure, market attributes and possible monopolistic behavior under the ITQ system are discussed in fairly general terms without formal analysis or much empirical data.

(5) On this basis, conclusions are drawn about the need for imposing excessive share limits in terms of quota holdings in the fishery

(6) Finally, on this basis of the above, "reasonable" excessive size limits in the SCOQ fishery are proposed without, however, providing good arguments for the proposals.

In addition to this, the Technical Group specifies a more general approach to setting excessive share limits in ITQ fisheries in general. This approach and its data and research requirements are summarized in Table ES-1. The procedure proposed is in broad terms in accordance with the one described for the SCOQ fishery above. It is in many respects a sensible and useful one.

2. *Evaluate the strengths and weaknesses of the proposed method developed by the NMFS Technical group for determining maximum possible allowable percentage share of quota ownership. Review and comment on the data requirements necessary for applying the proposed methods.*

B. Strengths

The approach described in the Technical Group Report (Mitchell et al. 2011) has certain important strengths:

(1) It is based on the standard theory of monopolistic competition.

(2) It is based on Horizontal Merger Guidelines (HMG), This has the advantage of guaranteeing symmetrical treatment with other industries.

(3) It is fairly clear and systematic.

(4) Within its own framework, it does not contain any serious errors as far as I could see.

B. Weaknesses

The approach proposed, however, also suffers from significant weaknesses.

(1) It is fairly superficial in the sense that it does not deal with the issues in sufficient depth. This applies in particular to the analysis of the ITQ system and its role in the creation and exercise of market power.

(2) It does not systematically cover all the key economic factors necessary for deciding a sensible counter-monopoly policy. In particular, it does not discuss (i) the deadweight loss of monopoly, (ii) the loss of economic efficiency that may result from counter-monopoly policies and (iii) the cost of imposing, enforcing and adjusting to such policies.

(3) It puts too much emphasis on the HH-index. This, as already discussed, suffers from severe limitations. It is also more appropriate to markets for homogenous goods which may be the case for quotas but is certainly not the case in the SCOQ product market and hardly in the market for landings.

(4) It contains no formal analysis of the fundamental factors affecting monopolistic behavior in the fisheries operating under ITQs. Addendum 2 to this report demonstrates that such an analysis in crucial.

(5) It hardly considers the monopsony problem (distributors vs. processors, processors vs. fishers) which may be of major importance in many fisheries including the SCOQ one.

C. Data requirements.

The needs for data to determine sensible "excessive share" limits are inadequately specified in the Technical Group Report. This, presumably, is primarily because the analysis needed to specify these data is missing in the report. The analysis in Addendum 2 suggests some of the data that are needed. These include (i) various price elasticities with respect to total harvest (output price, input prices and quota prices), (ii) the ratio of costs to revenues and (iii) the quota price to output price ratio. A more complete analysis would undoubtedly add more variables. To calculate the elasticities basically requires the estimation of demand and supply curves, which is equivalent to estimates of the production (or profit) functions at the various levels of the industry. In addition to this, data on the industry structure, level of quota holdings in each segment, possible company co-operation and collusion need to be obtained and investigated. Since all of these relationships and variables may alter over time, these data, moreover, need to be continuously updated. In summary: to set the appropriate "excessive size" limit in any given fishery a great amount of empirical information and investigation is needed.

3. E*valuate application of the proposed methods to the Surfclam/Ocean Quahog ITQ fishery. If there is disagreement with what the NMFS Technical Group recommended, clearly state that and your reason why.*

As already stated above, as a method to determine "excessive share" limits in the SCOQ fishery, the method proposed by the Technical Group suffers from serious weaknesses.

(1) It is quite superficial; it does not go into sufficient depth in analyzing this particular industry and the role of ITQs in any possible monopolistic behavior by the companies.

(2) It offers little data about the structure of the industry and market operation and virtually none about the crucial relationships including the key elasticities.

(3) It totally ignores important aspects of the situation such as the possible cost of monopolistic behavior, the benefits of returns to scale and the cost of imposing and operating "excessive size" limits.

(4) It for the most part ignores the monopsony problem.

(5) Its recommendation for an "excessive size" limit in this fishery seems rather 'ad hoc' and apparently not based on a solid theoretical or empirical foundation even within their rather limited frame of analysis.

I disagree with the Technical Group's recommendation about an excessive share cap in the SCOQ fishery. My disagreement is not that the proposed cap is necessarily wrong or that the two part cap is inappropriate. My disagreement is that I don't see any reasonable basis in the report or in the other data about this fishery that I have collected (see Appendix 1) to set this cap. If anything my own investigations, partly presented in Addendum 2 and the first part of this report, suggest that to the extent that a cap should be set, it should be substantially higher.

My basic conclusion is that there are insufficient data to set any cap at this stage and, therefore, especially given the possible costs involved, the prudent course of action is to refrain from doing so.

4. *Evaluate whether the approach outlined by the NMFS Technical group is reasonable for setting excessive share limits in fisheries managed through catch shares? As part of this TOR, comment on any constraints that may hinder application of the methods proposed by the NMFS Technical group.*

As already discussed above, the approach outlined in the *Technical Group* Report suffers from serious weaknesses of depth and omission. In particular:

(1) It lacks analysis of the role and effect of ITQs in monopolistic behavior. One consequence is that it does not identify the key relationships and variables that need to be empirically estimated. Another is that it does not explicitly relate the critical share to the empirical facts of the fishery situation.

(2) It omits dealing with key elements of the monopoly situation including (i) the deadweight loss of monopolistic behavior, (ii) the potential efficiency gains from exploiting returns to scale and (iii) the cost of implementing and operating "excessive share" limits.

Therefore, in my opinion, the approach as outlined in the Technical Group Report is inadequate as a general framework for setting excessive share limits in fisheries in general.

5. *Provide recommendations for further improvement*s

The procedure in the Technical Group Report as outlined e.g. in Table ES-1 and discussed in further detail in chapter VI of the report is, in my opinion, quite helpful. However, to be usable as guidance for setting excessive share limits in the SCOQ fishery and other ITQ fisheries it needs to be complemented by the following.

(i) A careful general theoretical of the factors that influence monopolistic behavior in ITQ fisheries in general.

(ii) A clear and well-developed prescription as to how to estimate and update the key relationships that are indentified by the theoretical study.

(iii) Additional steps having to do with the assessment of the "deadweight loss" of monopolistic behavior, the possible loss of scale efficiencies that might results from "excessive share" limits and the costs of implementing and operating a system of "excessive share" limits.

To carry out these additions and improvements requires considerable amounts of high level expertise and will inevitably be quite time-consuming and costly. However, given the number and economic value of fisheries already and potentially under ITQs in the US, the legal requirement to set excessive share limits, and the potential economic costs of setting such shares inappropriately, making this investment seems like a sensible way to proceed.

4. Conclusions and recommendations

What constitutes an excessive share in an ITQ fishery is a complicated issue. Because of the complications of ITQs and the dynamic nature of fisheries and ITQ-holdings, it is probably substantially more complicated than problems of limited competition in general.

The report submitted by the NMFS Technical Group (Mitchell et al. 2011) represent, a useful step toward understanding these issues. However, it is just one a step. It is, in my opinion, too lacking in the depth of its analysis and too narrow in scope to be acceptable to set sensible "excessive share" limits in both the SCOQ fishery and ITQ fisheries in general. More detailed reasons for this conclusion are provided in the main text of this report, especially chapter 3 and its addenda.

It is recommended that the work begun by the Technical Group Report be continued by further investigation into the conditions for monopolistic behavior in ITQ fisheries and the socially appropriate methods to deal with the problem. As in the Technical Group Report, this work should aim at developing theoretically consistent and empirically feasible procedures for judging the appropriate excessive share limits in ITQ fisheries in general.

Addendum 1
Monopolistic behavior: Basic theory

A general profit function for a company may be written as:

$$\pi(q, p(q)),$$

where q represents the production quantity and $p(q)$ the input and output prices faced by this company. These may in general depend on the quantity produced by the company with the first derivative of p being negative (more generally non-positive) for output prices and positive (more generally non-negative) for input prices. The profit function itself should be dome shaped in its first argument and monotonically increasing in output prices and decreasing in input prices.

For illustrative purposes, it is useful to write this profit function more explicitly as:

$$\pi(q, p(q)) = v(q) \cdot q - C(q, w(q)),$$

where v refers to output and w to input prices and $C(.,.)$ is the company's cost function.

In this context, market power exists if the company is large enough relative to the market detect a change in market prices if it alters the quantity, q, or, alternatively, if it can alter the price without the quantity dropping to zero.[5]

The socially optimal output level takes prices as exogenous and is defined by the condition:

$$\pi_1(q, p(q)) = 0,$$

where π_1 denotes the first derivative of the profit function w.r.t. the first argument. Let us refer to the socially optimal output level by q^*.

Firms with market power can affect prices by altering output and therefore do not generally take prices as exogenous. Their profit maximizing production level consequently is defined by:

$$\pi_1(q, p(q)) + \pi_2(q, p(q)) \cdot p_q = 0.$$

For both input and output prices the 2nd term would be negative provided $p_q \neq 0$.[6] It follows from the usual shape of the profit function that the monopoly production level, q_{mon}, say, is less than the socially optimal one, i.e., $q_{mon} \leq q^*$.

The monopoly situation is often illustrated as in Figure 1. In this figure, the monopolist is faced with a downward sloping demand curve, so he perceives $p_q < 0$. Therefore, rather than setting the quantity at the socially optimal level, q_{opt}, where the marginal profits

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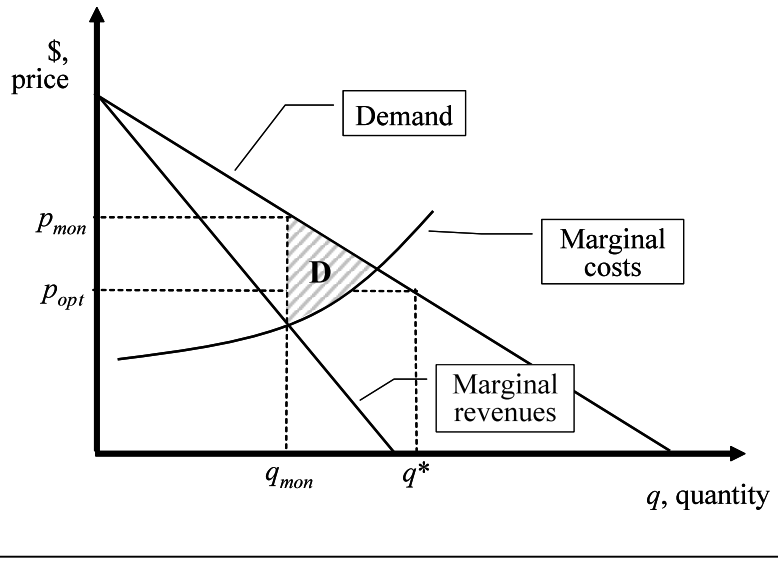
[5] In more technical language, the requirement for the existence of market power is that the elasticity of the output demand function and the input supply functions, as seen by the firm, be less than infinite.

[6] Note that $p_q = 0$ corresponds to perfectly elastic demand and supply functions.

are zero and the market price will be p_{opt}, he maximizes his profits by setting the quantity at q_{mon}, corresponding to a higher price p_{opt}. So, under the monopoly, the quantity is less and the market clearing price is higher than for the socially optimal behavior.

Figure 1
Monopoly behavior



Monopolistic behavior results in a social loss, a limited measure of which is often referred to as the deadweight loss of monopoly (Varian 1984).[7] This loss is illustrated as the striped area in Figure 1.

The deadweight loss of monopoly represents reduced economic efficiency and is the main economic reason for combating monopolistic behavior. However it is important to realize that this deadweight loss is often not very great and must, whatever it is, be set against any possible social benefits the monopoly (or oligopoly) may confer.

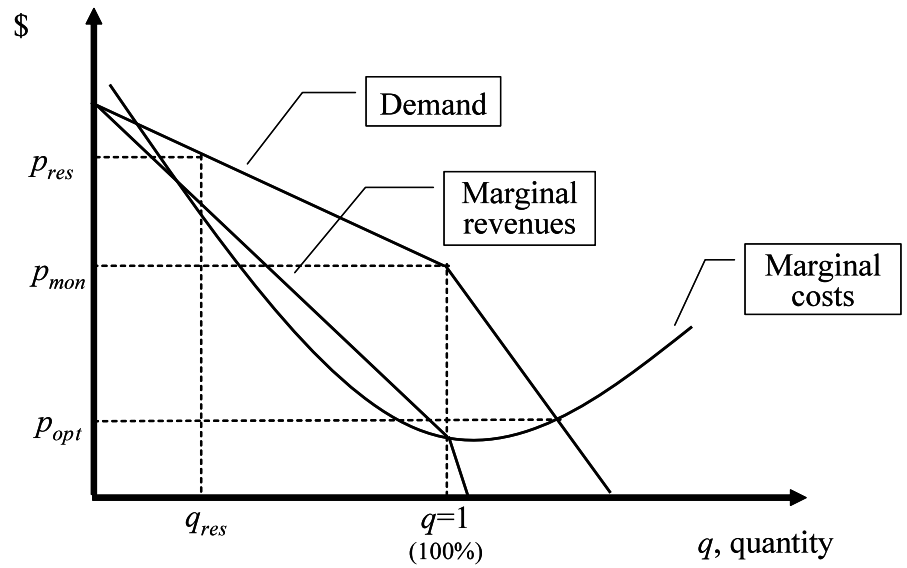
An important possible gain stemming from large companies relative to the total market (or industry) is that they may be able to reap returns to scale. This happens when the marginal cost function in Figure 1 is falling rather than rising and it corresponds to a situation when the marginal profit function is increasing rather than falling (non-concave) over some interval. If this is the case, forcing the large company to be reduced in order to curtail monopoly power may actually reduce overall social benefits. This is because the deadweight losses of monopoly behavior are less the gains from the scale economies realized by the large company.

A possible situation of this kind is illustrated in Figure 2. In this figure, strong increasing returns to scale result in a decreasing marginal cost function over a wide range of output. The demand function is illustrated as seen by the company. This is kinked at its 100% share of the market because the elasticity of demand (the elasticity of the demand curve) increases when the company gets competitors. The company maximizes its profits by producing at q=1 where it has 100% of the market. The price it receives at this quantity is p_{mon}, while the socially optimal price is p_{opt} which is much lower and at which price the total quantity would be higher. Consequently, this monopoly behavior results in a monopoly deadweight loss, i.e. a social loss.

[7] The deadweight loss of monopoly is a limited measure of the actual social loss because it doesn´t involve general equilibrium considerations or consider the dynamic or economic growth impacts of the monopolistic behavior.

Let us now assume that in an attempt to rectify this situation the maximum relative size of the company is restricted to some fraction of the total market indicated by q_{res} in Figure 2. But at this quantity most of the returns to scale are lost and the actual market price, $p_{re,}$, is higher than under the unrestricted monopoly. It is easy to check that the total consumer and producer surplus under the restricted company size situation is less than in the monopoly situation. In other words, the deadweight loss of monopoly in the initial situation is less than the loss in returns to scale in the restricted situation.

Figure 2
Monopoly behavior: Increasing returns to scale



The situation depicted in Figure 2 is often referred to as natural monopoly. This is because the marginal cost function is still declining at the size of the market (albeit not at the optimal size of the market as the figure is drawn). Since the situation is one of natural monopoly, it is not a good idea to restrict the size of the company.

Note that this does not suggest that the initial situation of monopoly is ideal. There is a significant deadweight loss in that situation as we have seen. The point is that dealing with that situation by restricting company size is counterproductive — it results in more losses than gains. A more appropriate policy is to permit the natural monopolist to persist but find ways to reduce the price he is charging.

Addendum 2
Monopolistic behavior in an ITQ fishery: Analysis

In an ITQ fishery, the harvest volume (the basic quantity in the fishery) is bounded above by the TAC (total allowable catch). If the TAC is binding, there is limited room for monopolistic behavior by the fishing firms.[8] However, in ITQ fisheries, fishing firms may withhold quotas from fishing, thus controlling the effective TAC. This may, among other things, increase output prices (monopoly) and reduce input prices (monopsony) and thus potentially increase the firms' profits. The conditions under which this would be profitable for firms are not immediately obvious.

The following examines the conditions under which this kind of monopolistic (monopoly, oligopoly and monopsony) behavior would be profitable for individual firms or a cartel of firms. Unfortunately, it turns out that the relationships involved are somewhat complicated and some of the results are not totally obvious, even when contemplated ex post. Therefore, I have felt it necessary to spell out some of the less obvious aspects of the analysis at considerable length. To compensate for this increase in length, an attempt will be made to summarize the most pertinent results of the analysis toward the end of this chapter.

The fishery

Consider a fishery composed of a number of firms I, $I>0$. Let the profit function of any firm i be:

$$\pi(p;q,x;i),$$

where p refers to input and output prices, q the volume of harvest and x biomass. The profit function is assumed to have the usual properties, i.e., to be (i) differentiable in all variables, (ii) concave in both q and x, (iii) monotonically increasing in biomass and output prices, (iv) having a maximum in q and (v) monotonically decreasing in input prices.

Note 1: The variable (or vector) p is included in this profit function to allow for possible monopolistic behavior. At a later stage this variable will be decomposed into output and input prices to allow for monopsony as well as monopoly.

Note 2: As it is specified the profit functions may differ from one firm to another.

Fisheries management

Let this fishery be managed by ITQs. The fisheries manager sets the TAC (hereafter referred to as Q) so as to maximize the present value of the sum of consumer and producer surplus flowing from the fishery. This is the standard fisheries problem (see e.g. Clark 1975). In the ITQ-context the fisheries management problem may be expressed as (Arnason 1990):

[8] Monopolistic behavior ultimately consists of manipulating quantities to affect prices or, equivalently, setting the prices and accepting the resulting quantities.

$$\text{(I)} \qquad \underset{Q}{Max} \int_0^{\infty} \left(\sum_{i=1}^{I} \pi(p, q(i), x, i) \right) \cdot e^{-r \cdot t} \, dt$$

$$s.t. \;\; \dot{x} = G(x) - Q$$

$$q(i) = \Psi(Q; p, x; i)$$

$$\sum_{i=1}^{I} q(i) = Q$$

Note 3: The second constraint expresses the individual harvesting response to the management control, Q.

Note 4: Profit maximization taking prices as constant implies the maximization of the sum of consumer and producer benefits (Varian 1984).

Note 5: Setting Q so as to solve problem (I) leads to the socially optimal Q, Q^*, say.

Note 6: Corresponding to Q^*, there will be the socially optimal shadow value of biomass, λ^*, say.

Note 7: The ITQ system leads to the socially optimal rental price of ITQs (per volume), s^*, say.

Note 8: If the TAC is set optimally, $Q=Q^*$, then $s^* = \lambda^*$ (Arnason 1990).[9]

Fishing firm behavior

Under the ITQ system, firms hold quota-shares (possibly zero). They may alter these quota share holdings by trading. They may also buy and sell (rent in or out) annual (seasonal) quantity quotas (non-permanent) at the market price s. By withholding quantity quotas from fishing they reduce the total catch below the TAC level, which may affect:

(1) Fishery input and output prices, p.
(2) The rental price of quotas, s.
(3) The evolution of the biomass, x.
(4) The price of quota shares.

Note 9. The price of quota shares is an asset price and is not going to affect monopolistic behavior at any given point of time. Therefore, share quotas and share quota prices can apparently be ignored in this analysis. Moreover, since rental prices of quotas and quota share prices are functionally dependent on each other by trading arbitrage (Arnason 1990), it suffices to consider the former.

Note 10. The firm can only affect prices by withholding quota. This is because total supply of outputs and, therefore, the demand for inputs equals the exogenous TAC less the quantity of quota that is withheld from fishing.

Note 11. Since withholding quota means that the effective TAC is reduced, the rental price of quota will generally be positively affected by quota withholding.

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[9] This actually follows immediately from socially optimal fishing which implies $\pi_{q(i)} = \lambda^*$ all active i and actual fishing under ITQs which implies $\pi_{q(i)} = s$ all active i.

Given this, the following summarizes the relevant profit maximization problem for firm i.[10]

$$\text{(II)} \qquad \underset{q,\Delta}{Max} \int_0^{\infty} \left(\pi(\, p(Q-\Delta),\, q-\Delta,\, x;\, i) - s(Q-\Delta)\cdot q\right)\cdot e^{-r\cdot t}\, dt$$

$$s.t.\ \ \dot{x} = G(x) - Q - \Delta$$
$$q\text{-}\Delta \geq 0,\ \Delta \geq 0,$$

where q and Δ denote the quota held by the firm and quota withheld from fishing, respectively. The functions $p(Q-\Delta)$ and $s(Q-\Delta)$ represent the input/output price equations and quota rental price equations respectively.

Note 12. q-Δ represents the harvest by the firm. It is convenient to refer this by $h(i) \equiv q$-Δ.

Note 13. Q-Δ represents total harvest. Let us refer to this as H= Q-Δ.

A Hamiltonian function for problem (II) may be written as:

$$H = \pi(\, p(Q-\Delta), q-\Delta, x; i) - s(Q-\Delta)\cdot q + \sigma\cdot(G(x) - Q + \Delta)\,,$$

where σ is the firm's private evaluation of the shadow value of biomass.

Necessary conditions for solving (II) include:

(II.1) $\pi_{h(i)} = s$, for active firms.

(II.2) $-\pi_p \cdot p_H - \pi_{h(i)} + s_H \cdot q + \sigma \leq 0,\ \Delta \geq 0,\ (-\pi_p \cdot p_H - \pi_{h(i)} + s_H \cdot q + \sigma)\cdot \Delta = 0$

Expression (II.2) is the key to understanding monopolistic behavior in an ITQ fishery. Therefore, in what follows, we will focus on this expression.

(II.2) is designed for a fishing or an integrated fishing fish processing firm. It does not directly cover the case of a quota holder who does neither but just rents out his quota. Without going into detail, a corresponding expression for that situation may be expressed as:

(II.2') $s_H \cdot (\Delta - \overline{q}) - s + \sigma \leq 0,\ \Delta \geq 0,\ (s_h \cdot (\Delta - \overline{q}) - s + \sigma)\cdot \Delta = 0\,,$

where $\overline{q}$ is the quota holdings of the agent.

Monopolistic behavior

As stated above, in an ITQ fishery a fishing firm can exert market power by withholding quota from fishing. In fact, since this is the only way to alter quantities, this or the threat of this may be regarded as the only way to exert market power. For instance, trying to get

[10] It may be noticed that there are no quota shares. This is because quta shares only relate to the dynamic asset side of the problem and to study the fishery monopoly problem as stated above, it is sufficient to consider an ITQ fishery without permanent quota shares.

suppliers to accept a lower input price and buyers a higher output price requires at least a credible threat of reduced quantities. Similar arguments apply to cartels of firms.

Expression (II.2) shows that quota will be withheld only if the marginal benefits of quota withholding, $\partial H/\partial \Delta$, evaluated at $\Delta=0$ is positive. This, of course, is highly intuitive. Formally we express this as.

(1) $$\left.\frac{\partial H}{\partial \Delta}\right|_{\Delta=0} = -\pi_p \cdot p_H - \pi_{h(i)} + s_H \cdot q + \sigma > 0.$$

This expression is the fundamental condition for it to be profitable for a fishing firm (or a cartel of such firms) to withhold quota from fishing. Careful examination of this equation will elicit the conditions under which this can happen. Among other things, (1) involves a number of price elasticities as well as the size of the firm relative to the total size of the fishery. Therefore, (1) will indicate the relative size of the firm as a function of elasticities at which monopolistic behavior could become a possibility. Of course (1) represents a basic theoretical relationship. For actual fisheries, it needs to be supplied with the empirical structure of the fishery and the numerical estimates of the parameters.

In order to bring out more clearly the main message of expression (1), it may be useful to seek to simplify it.

S-1. For an output price, $\pi_p = h(i)$, [Hotelling's lemma, Varian (1984)].
For an input price, $\pi_p = -z(i)$, where $z(i)$ represents the quantity of inputs, [Hotelling's lemma, Varian (1984)].

S-2. By (II.1), $\pi_{h(i)} = s$, provided firm i is active in the fishery. (Note that if this is not the case $\pi_{h(i)} < s$).

S-3. Clearly, $p_H \equiv E(p,H)\cdot\frac{p}{H}$, $w_H \equiv E(w,H)\cdot\frac{w}{H}$, $s_H \equiv E(s,H)\cdot\frac{s}{H}$, where $E(a,b)$ denotes the elasticity of a with respect to b.

S-4. In (1), $q \equiv q(i) = h(i)$ since the expression is evaluated at $\Delta=0$.

S-5. In (1), $\sigma \equiv \sigma(i) \approx \left(\frac{h(i)}{H}\right)\cdot\lambda^* = \left(\frac{h(i)}{H}\right)\cdot s$. [The approximately equal sign, "≈", is shown in Arnason (1990), the last equality sign follows from Note 7 above.

Adopting simplifications S-1 to S-5 and representing input prices by w and output prices by p modifies (1) to:

(2) $$\left.\frac{\partial H}{\partial \Delta}\right|_{\Delta=0} = -\frac{h(i)\cdot p}{H}\cdot E(p,H) + \frac{z(i)\cdot w}{H}\cdot E(w,H) - s + \frac{h(i)\cdot s}{H}E(s,H) + \frac{h(i)}{H}\cdot s > 0.$$

Now, let the relative size of the firm be defined by $\alpha(i) \equiv \frac{h(i)}{H}$.

Note 14. Evaluated at Δ=0, $\alpha(i) \equiv h(i)/H \equiv q(i)/Q$, i.e. the quota holding of company *i*.

Inserting this in (2) and simplifying we find:

$$(3) \qquad \left.\frac{\partial H}{\partial \Delta}\right|_{\Delta=0} = -\alpha(i)\cdot E(p,H) + \alpha(i)\cdot\frac{z(i)\cdot w}{p\cdot h(i)}\cdot E(w,H) - \frac{s}{p} + \alpha(i)\cdot\frac{s}{p}\cdot E(s,H) + \alpha(i)\cdot\frac{s}{p} > 0\,.$$

The expression $\frac{z(i)\cdot w}{p\cdot h(i)}$ represents the cost-revenue ratio for the firm. Let us denote this ratio by $\beta(i)$, i.e. $\beta(i) \equiv z(i)\cdot w/p\cdot h(i)$. With that inserted expression (3) becomes

$$\left.\frac{\partial H}{\partial \Delta}\right|_{\Delta=0} = -\alpha(i)\cdot E(p,H) + \alpha(i)\cdot\beta(i)\cdot E(w,H) - \frac{s}{p} + \alpha(i)\cdot\frac{s}{p}\cdot E(s,H) + \alpha(i)\cdot\frac{s}{p} > 0$$

Rearranging yields the following boundary expression for the size of the firm, $\alpha(i)$[11]:

$$(4) \qquad \boxed{\alpha(i) > \frac{1}{1 + E(s,H) + \left(\beta(i)\cdot E(w,H) - E(p,H)\right)\cdot\frac{p}{s}}}\,.$$

Expression (4) gives the relative size of the company, i.e. $\alpha(i)$ for which it is profitable for it to withhold quota from fishing. The largest relative size before this becomes profitable is given by

$$(5) \qquad \boxed{\alpha(i) = 1\Big/\left(1 + E(s,H) + \left(\beta(i)\cdot E(w,H) - E(p,H)\right)\cdot\frac{p}{s}\right)}$$

We refer to this $\alpha(i)$ as the critical size of the firm. For any size less or equal to the critical size, it will not be profitable for the firm to withhold quota from fishing-, even if it has market power. For any relative size greater than the critical size, withholding quota will be profitable.

It is convenient to summarize the content of (5) in the following general expression:

$$\alpha_{crit} = \Lambda(E(p,H), E(w,H), E(s,H), s/p, \beta)\,.$$

So, the critical size of the company depends on (i) the elasticity of output price with respect to total harvest, $E(p,H)$, (ii) the elasticity of input price with respect to total harvest, $E(w,H)$. (this represents the monopsony aspects of the situation), (iii) the elasticity of the quota rental price with respect to total harvest, $E(s,H)$, (iv) the output price/quota price ration, p/s, and (v) the cost/revenue ratio, $\beta(i)$.

From (5) it is easy to see that

- The (numerically) higher the elasticity of output and input prices with respect to harvests the lower is the critical size of the firm.

[11] Provided the denominator is positive.

- The higher (numerically) is the elasticity of the quota rental price with respect to harvests the larger is the critical size of the firm.
- The higher the p/s ratio, i.e. the lower the marginal profits of fishing, the lower is the critical size of the firm.
- The higher is the cost to revenue ratio, $\beta(i)$, the lower is the critical firm size.

All these results seem in accordance with a priori economic reasoning. The result that monopoly behavior becomes more profitable with increasing elasticity of price with respect to quantity (less elastic supply and demand curves) is well known (Varian 1984, Tirole 1989). The result for the quota rental price is somewhat novel. However, recognizing that the cost of withholding quota from fishing is equivalent to the quota rental price and that this price increases with the quantity of quota withheld, the result is readily understandable. This also explains the role of the quota rental price in the output price/quota price ratio. Clearly the benefits of quota withholding increase with the price of fish, but they decrease with the rental price of quota as discussed. Finally the cost to revenue ratio is merely a weight on the elasticity of input price with respect to harvest and therefore has exactly the same effect.

The critical firm size: Numerical calculations

Inserting empirical estimates for the arguments (independent variables) in (5) makes it possible to calculate the critical firm size. In the absence of such estimates plausible guesstimates may be used. Such plausible values are listed in Table 1. Since below we will conduct tests of the sensitivity of the critical firm size to these specifications, we refer to them as the base levels.

Table 1
Assumed base values for the arguments in (5)

Argument	Assumed values	Comments
$E(p,H)$	-0.5	This is equivalent to the more commonly used $E(H,p)$=-2
$E(w,H)$	0.2	This is equivalent to the more commonly used $E(H,w)$=5
$E(s,H)$	-1	
s/p	0.5	
β	0.5	Note that 1-β = profits/revenues

Many empirical studies of the elasticity of fish price to supply suggest low elasticities (highly elastic demand curves, see e.g. Asche and Bjondal 1999). Presumably, this is because of the ready availability of substitutes. Accordingly a demand elasticity of -2 is assumed. The elasticity of input prices in fisheries (labor, capital and materials) is usually very low, especially in well developed market economies. This is because of highly elastic supply. The supply elasticity of 5 is assumed suggesting that when the use of inputs is doubled the price increases by 20%. Little is known about the elasticity of quota price with respect to harvest quantity. This reflects the elasticity of the marginal profit function (demand function for quotas. Assuming unitary elasticity for this seems reasonable.

At the base levels listed in Table 1, the critical firm size is 0.83, i.e. a firm needs to have 83% of the industry before it becomes profitable to withhold quotas. It should be emphasized, however, that this outcome depends on the base level assumptions listed in the table. Thus, it should be regarded as an example rather than an empirical result.

Rather than calculating specific values, it may be more informative to examine how the critical firm size depends on the arguments of (5). Doing that essentially defines a sub-space in the space of relative firm sizes and the functional arguments in (5) where monopolistic behavior becomes profitable. Depicting this subspace, however, is not easy. Therefore, in what follows we resort to a simpler device.

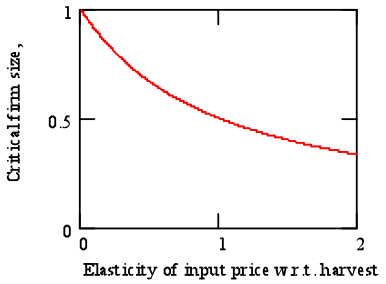
First consider the dependence of the critical firm size on each of the three elasticities in expression (5) keeping the other arguments in (5) constant. This is done in the following sets of diagrams (Figures 1-3).

Figure 1
Critical firm size as a function of elasticity of output price w.r.t. total harvest

The schedule of the critical firm size as a function of the elasticity of output price with respect to harvest volume is drawn in Figure 1. When the size of the firm is above the schedule, it is profitable to withhold quotas. As indicated in the diagram, with $E(p,H)$=-0.1, the critical firm size is above 100%. It is about 83% for $E(p,H)$=-0.5 and 45% for $E(p,H)$=-1. With $E(p,H)$=-2, the critical firm size drops to about 24%.

The schedule of the critical firm size as a function of the elasticity of output price with respect to harvesting quantity is drawn in Figure 2. Note that this schedule measures the profitability of monopsonistic rather than monopolistic behavior. As before the firm sizes for which it is profitable to withhold quota are located above the schedule. As shown in the diagram, when the $E(w,H)$=0, the critical firm size is 100%. So, for this elasticity of input price and the base level assumptions for the other arguments of (4), there is no tendency for monopolistic behavior even at 100% firm size. This, of course, is a coincidence of the numerical specifications. With $E(w,H)$=0.2, the base-level assumption, the critical firm size is about 83% as before. With $E(w,H)$=0.5, the base-level assumption, the critical firm size is about 67%. Finally with $E(w,H)$=1, the base-level assumption, the critical firm size is about 50%.

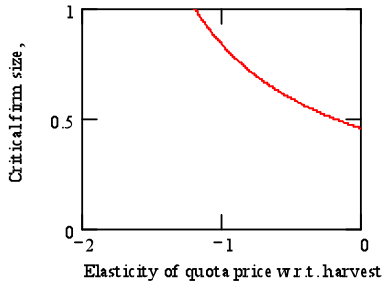
Figure 2
Critical firm size as a function of elasticity of input price w.r.t. total harvest



The schedule of the critical firm size as a function of the elasticity of quota price with respect to harvest is drawn in Figure 3. The interpretation of this schedule is the same as before. Note that the higher the numerical value of this elasticity, the larger is the critical firm size. Thus,

for any elasticity less than -1.2, other arguments of (4) at their base levels, the critical firm size is above 100%.

Figure 3
Critical firm size as a function of elasticity of quota price w.r.t. total harvest



The sensitivity of the critical firm size to deviations in the base level assumptions is illustrated in Figure 4. In this diagram, the base level assumptions of Table 1 are altered from -50% to +50% and the resulting critical firm size calculated. (Note that a -50% reduction in negative elasticities results in a numerical increase in their values).

Figure 4
Sensitivity of the critical firm size to base level assumptions

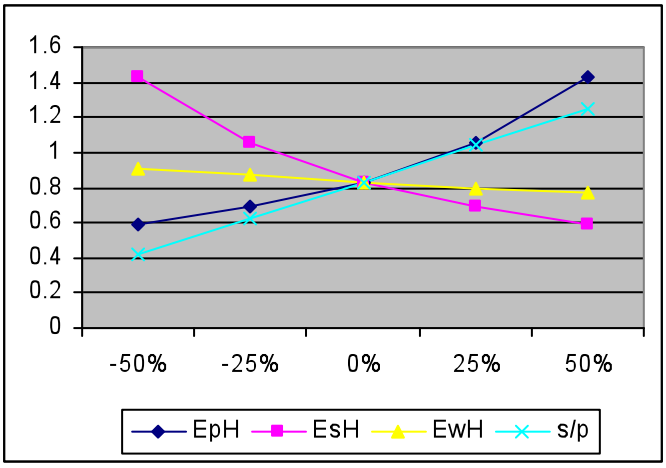


Figure 4 illustrates that the critical firm size is most sensitive to changes in the elasticities of output price and quota price to harvests and the *s/p* ratio. As the elasticity of output price with respect to harvests gets greater (becomes more negative) the smaller the critical firm size and vice versa for the elasticity of quota price. Compared to these impacts the effect of the input price elasticity is smaller. The higher the *s/p* ratio the larger the critical firm size. This makes full sense. One of the costs of withholding quotas is the price of quota. The higher this is relative to the output price the greater this cost.

Conclusions

The above analysis suggests certain seemingly robust results of a general nature:

- Expressions (1), (4) and (5) show that the critical size of firms, i.e. the size before monopolistic behavior becomes profitable, is in general a complicated function involving several variables and relationships. It follows that a sensible analysis of possible monopolistic behavior under ITQ systems must take account of these complexities.
- The expressions for the critical firm size show that even when market power exists (in the sense that withdrawal of quota will affect prices), it is often not profitable for the firms to exercise this power. It follows that a mere study of market power is insufficient to set a sensible limit on fishing firm size.
- The critical firm size depends on several empirical aspects of the fishery. Many of these aspects are highly variable over time. Moreover, it appears that the critical firm size may be quite sensitive to the numerical values of these empirical aspects. It follows that to set the critical firm size sensibly requires a careful, frequently updated empirical studies.

It is important to realize that the above analysis is subject to considerable limitations. Most importantly, it is limited to studying when it would be profitable for fishing firms to exercise whatever market power they have. It does not even attempt to answer the broader question as to when it would be socially beneficial to impose relative size limitations on fishing firms. Clearly, this would only be beneficial when the following apply.

(1) It is profitable for firms to exercise market power. A necessary (but not sufficient) condition for that is that the firms have exceeded the critical size.

(2) The social costs of larger firms (in terms of deadweight loss) is greater than the social benefits (in terms of increased efficiency (i.e., lower average cost of output)

(3) The costs of enforcing the size constraint is less than the net benefits it generates.

In addition to this, the expressions for the critical firm size are based on certain crucial assumptions.

- The first crucial assumption is that other firms do not react (by following suit). If they do, the individual benefits will be different. Often they will be larger. However, they can be less depending on the various elasticities entering (1) and (4) and how they change with the level of harvest. The analysis of what will happen if the other firms react belongs to the field of game theory and is beyond the scope of this analysis.
- The second crucial assumption is that the firm can act without risk of negative consequences in terms of penalties for monopolistic behavior and negative reputation. If these risks exist, the critical firm size before withdrawing quotas becomes truly profitable will be larger than described above.

Appendix 1
Bibliography

Material provided for review

Mitchell, G., S. Peterson and R. Willig. 2011. *Recommendations for Excessive-Share Limits in the Surfclam and Ocean Quahog Fisheries*. Compass Lexecon Inc. Boston.

MAFMC and NMFS. 2010. *Overview of Surfclam and Ocean Quahog Fisheries and Quota Considerations for 2011,2012 and 2013*. Mid-Atlantic Fishery Management Council in cooperation with National Marine Fisheries service. Dover, Delaware.

Presentations during the Peer Review Meeting

Peterson, S and G. Mitchell. 2011. On Excessive-Share Limits in the Surfclam and Ocean Quahog Fisheries. PowerPoint presentation. CIE Peer Review Meeting. Falmouth. June 21.

Other useful background material

Adelaja A., J. Menzo and B. McCay. 1998. Market Power, Industrial Organization, and Tradeable Quotas. *Review of Industrial Organization* 13: 589–601.

Anderson, L. G. 2008. The Control of Market Power in ITQ Fisherie. *Marine Resource Economics*, 23:25–35.

Anderson, L.G. 1991. A Note on Market Power in ITQ Fisheries. *Journal of Environmental Economics and Management* 21(3):291–96.

Anonymous. 2010. *Horizontal Merger Guidelines*. U.S. Department of Justice and the Federal Trade Commission August 19, 2010.

Arnason, R. 1990. Minimum Information Management in Fisheries. *Canadian Journal of Economics* 23(3):630-53.

Asche, F. and T. Bjorndal. 1999. *Demand Elasticities for Fish: A Review*. Globefish Specieal series 9. Food and Agriculture Organization. Rome.

Clark, C.W. 1976. *Mathematical Bioeconomics: The Optimal Management of Renewable Resources*. John Wiley & Sons.

FAO. 2011. http://www.fao.org/fishery/species/3538/en. Food and Agriculture Organization of the United Nations.Rome.

Hahn, R.W. 1984. Market Power and Transferable Property Rights *Quarterly Journal of Economics* 99:753–65.

Herfindahl, O. 1950. Concentration in the U.S. Steel Industry. Unpublished doctoral dissertation, Columbia University, 1950.

Hirchman, A.O. 1945. *National Power and the Structure of ForeignTrade*. Berkeley 1945.

Hirchman, A.O. 1964. The Paternity of an Index. The American Economic Review, 54:761-2.

Landes, W. and R. Posner. 1981. Market Power in Anti-trust Cases. Harvard Law Review 94:939-96

Lerner, A. 1934. The Concept of Monopoly and the Measurement of Monopoly Power. *Review of Economics and Statistics* 1:157–75.

Marvin, K. A. 1992. Protecting Common Property Resources through the Marketplace: Individual Transferable Quotas for Surf Clams and Ocean Quahogs. *Vermont Law Review* 16:1127-68.

McEvoy, D.M. S. Brandt, N. Lavoie and S. Anders. 2009. The Effects of ITQ Management on Fishermen's Welfare When the Processing Sector Is Imperfectly Competitive. *Land Economics* 85:470-84.

Mirman, L.J., L.Samuelson and A. Urbano. 1993. Monopoly Experimentation. *International Economic Review*. 34: 549-63.

Social Sciences Branch. 2009. *Excessive Share Issues in the Surfclam and Ocean Quahog ITQ Fishery*. Report to the Surfclam and Ocean Quahog FMAT. Northeast Fisheries Science Center. Woods Hole, MA.

Tirole, J. 1989. *The Theory of Industrial Organization*.3rd ed. MIT Press. Cambridge MA.

Varian, H. 1984. *Microeconomic Theory*. Second edition. W.W. Norton & Company. New York.

Appendix 2
Statement of Work for Dr. Ragnar Arnason

External Independent Peer Review by the Center for Independent Experts

Evaluation of excessive shares study in the Mid-Atlantic surfclam and ocean quahog ITQ fishery

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: Recently, the Mid-Atlantic Fishery Management Council has been crafting Amendment 15 to the Surfclam and Ocean Quahog Fishery Management Plan, and as part of the Amendment, has been attempting to define an "excessive share" threshold for the Individual Transferable Quota (ITQ) portion of the fishery. Regarding share accumulation, section 303A(c)(5)(D) of the 2006 reauthorized Magnuson-Stevens Act states that ITQ privilege programs should ensure that limited access privilege holders do not acquire an excessive share of the total limited access privileges in the program. In addition, National Standard 4 of the Magnuson Act (16 *U.S.C.* 1851(a)(4)) requires that fishing privilege allocations be carried out so that "no particular individual, corporation, or other entity acquires an excessive share of such privileges." During the course of the Council's deliberations on the market power excessive share issue, it was decided that additional expertise was needed to examine the economic rationale behind the excessive share determination, and to recommend an excessive share level, if needed. In order to provide this expertise, a Technical Group of Experts (not the CIE) is being assembled to give advice on the appropriate excessive share threshold for the surfclam and ocean quahog ITQ system. This Technical Group will assess available models for evaluating the presence of market power, and make recommendations with regard to their appropriateness for setting excessive catch share limits.

The work being performed by this Technical Group could be controversial. It will establish methods for determining excessive shares which might be applied in other fisheries (besides surfclams and ocean quahogs). With the movement by NMFS to catch share systems, determining what constitutes an excessive share and whether limits need to be put in place is extremely important because excessive share may lead to market power. Market power can lead to the ability to influence price in either the final product market or for factors of

production (i.e. the fish resource). Examination of market share has never been formally investigated in this fishery. Thus the study by the Technical Group will be innovative and significant.

After the Technical Group has delivered its recommendations, a peer review (by the CIE) needs to take place to either endorse or reject the findings from the Technical Group. This two-step process was agreed to by the Northeast Fisheries Science Center (NEFSC) and the Mid-Atlantic Fishery Management Council (MAFMC).

The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have working knowledge and recent experience in the application of economics, with specific expertise in industrial organization. The reviewers should have theoretical and empirical expertise in the economics of market structure/conduct/performance, particularly monopoly/oligopsony, antitrust, firm strategy, and government regulation. Experience conducting studies using econometric models and/or index-based assessments of market concentration and market power would be useful. Experience with markets operating under government permits such as production permit or marketing orders in agriculture, bandwidth for TV and radio, and tradable permit systems like ITQ's in fisheries would be desirable. Empirical studies of market structure in renewable resource industries would be desirable as would an understanding of the statutory context for antitrust regulation. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Not covered by the CIE, the CIE chair's duties should not exceed a maximum of 14 days (i.e., several days prior to the meeting for document review; the CIE panel meeting in Woods Hole; several days following the open meeting for SARC Summary Report preparation).

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in Woods Hole, Massachusetts during 21-23 June 2011.

Statement of Tasks: Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

1. Prior to the Peer Review Meeting:

Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email, FAX) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair (see below) a copy of the SoW, background documents and final report in advance of the panel review meeting. Any

changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, home country, and FAX number) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

Pre-review Background Documents: Approximately two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

2. During the Open Meeting

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Review Meeting Chair

A member of the Mid-Atlantic Management Council Scientific and Statistical Committee will serve as Chairperson. The role of the Chair is to facilitate the meeting, which includes coordination of presentations and discussions, and making sure all Terms of Reference are reviewed. Additionally, the Chair shall prepare the summary report from the meeting. During the meeting the Chair can ask questions or make statements to clarify discussions, and he can move the discussion along to ensure that the CIE reviewers address all of the TORs.

CIE Reviewers

Each CIE reviewer shall participate as a peer reviewer in a panel discussion centered on a report furnished to NMFS by the Technical Group of Experts regarding excessive shares in the surfclam and ocean quahog fishery. Reviewers are to determine whether the findings of the Technical Group are valid given the Terms of Reference provided to the expert panel. If reviewers consider the recommendations of the expert panel to be inappropriate, the reviewers should recommend an alternative.

During the question and answer period, a representative of the NMFS expert panel will be available to answer questions about the report. The CIE members can provide feedback to the expert panel member at that time.

Other Panel Members

A representative from the Mid-Atlantic Fishery Management Council staff, and the Northeast Fisheries Science Center Social Sciences Branch will be available during the meeting to provide any additional information requested by the CIE reviewers. Other panel members may assist the Chair prepare the summary report, if requested.

3. After the Open Meeting

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: The Chair from the SSC and CIE reviewers will prepare the Peer Review Summary Report. Each CIE reviewer will discuss whether they hold similar views on each Term of Reference and whether their opinions can be summarized into a single conclusion for all or only for some of the Terms of Reference. For terms where a similar view can be reached, the Summary Report will contain a summary of such opinions. In cases where multiple and/or differing views exist on a given Term of Reference, the Report will note that there is no agreement and will specify - in a summary manner – what the different opinions are and the reason(s) for the difference in opinions.

The Chair's objective during this Summary Report development process will be to identify or facilitate the finding of an agreement rather than forcing the panel to reach an agreement. The Chair will take the lead in editing and completing this report. The Report (please see Annex 1 for information on contents) should address whether each Term of Reference was completed successfully. For each Term of Reference, this report should state why that Term of Reference was or was not completed successfully.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.

2) Participate during the panel review meeting at the Northeast Fisheries Science Center, Woods Hole, MA laboratory during 21-23 June, 2011 as specified herein, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than 7 July, 2011, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts", and the report should be sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

17 May 2011	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
7 June 2011	NMFS Project Contact sends the CIE Reviewers the pre-review documents
21-23 June 2011	Each reviewer participates and conducts an independent peer review during the panel review meeting
7 July 2011	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
14 July 2001	Draft of Summary Report, reviewed by all CIE reviewers, due to panel Chair *
21 July 2001	Panel Chair send final Summary Report, approved by CIE reviewers, to NEFSC contact
21 July 2011	CIE submits CIE reports to the COTR
28 July 2011	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

*The Summary report will not be submitted, reviewed, or approved by the CIE

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee,

these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) each CIE report shall completed with the format and content in accordance with **Annex 1**,
(2) each CIE report shall address each ToR as specified in **Annex 2**,
(3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

William Michaels, Program Manager, COTR)
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Key Personnel:

NMFS Project Contact:

John B. Walden
Northeast Fisheries Science Center
166 Water Street, Woods Hole, MA 02536
John.Walden@noaa.gov

Phone: 508-495-2355

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations in accordance with the ToRs.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Evaluation of excessive shares study in the Mid-Atlantic surfclam and ocean quahog ITQ fishery

The peer review shall be conducted based on the following Terms of Reference (ToRs):

1. Describe the method or process used by the NMFS Technical Group for determining the maximum possible allowable percentage share of quota ownership that will prevent an entity from obtaining market power.

2. Evaluate the strengths and weaknesses of the proposed method developed by the NMFS Technical group for determining maximum possible allowable percentage share of quota ownership. Review and comment on the data requirements necessary for applying the proposed methods.

3. Evaluate application of the proposed methods to the Surfclam/Ocean Quahog ITQ fishery. If there is disagreement with what the NMFS Technical Group recommended, clearly state that and your reason why.

4. Evaluate whether the approach outlined by the NMFS Technical group is reasonable for setting excessive share limits in fisheries managed through catch shares? As part of this TOR, comment on any constraints that may hinder application of the methods proposed by the NMFS Technical group.

5. Provide any recommendations for further improvement

Annex 3: Tentative Agenda

Evaluation of excessive shares study in the Mid-Atlantic surfclam and ocean quahog ITQ fishery

Falmouth and Woods Hole, Massachusetts during 21-23 June 2011

Tuesday, June 21. Holiday Inn, Lighthouse Room, Jones Road, Falmouth, MA

9:00-9:15 AM
Opening
Welcome
Introduction — SSC Chair
Agenda
Conduct of Meeting

9:15 – 9:30 Background and Need for Expert Panel Report – Lee Anderson
9:30-11 Report of the NMFS Expert Panel - NMFS Expert Panel Rep.

11-11:15 Break

11:15 -Noon Review Terms of Reference – CIE Panel

Noon – 1:15 Lunch

1:15 – 3:00 CIE Panel Discussion – Terms of Reference #1.

3:00-3:15 Break

3:15-4:00 Public Comments
4:00-4:45 CIE Panel Discussion – Terms of Reference #2
4:45-5:00 Questions for following day

Wednesday, June 22. Holiday Inn, Lighthouse Room, Jones Road, Falmouth, MA

9:00-9:30 Review any outstanding questions from previous day
9:30-10:30 CIE Panel Discussion – Terms of Reference #3

10:30-10:45 Break

10:45-Noon CIE Panel Discussion – Terms of Reference #4

Noon-1:30 Lunch

1:30 – 3:00 CIE Panel Discussion – Terms of Reference #5

3:00-3:15 Break

3:15-5:00 CIE Panel Discussion – Outstanding Issues

Thursday June 23 Location: Clark Conference Room, Northeast Fisheries Science Center.

9:00 – 5:00 Report writing (Meeting Closed to Public)

Appendix 3
Peer Reviewer Panel

Ani Katchova. Assistant Professor, Department of Agricultural Economics, University of Kentucky akatchova@uky.edu

Rigeberto Lopez. **Professor,** Agricultural and Resource Economics, University of Connecticut rigoberto.lopez@uconn.edu

Ragnar Arnason. Professor, Department of Economics, University of Iceland. ragnara@hi.is

Chair
James E. Wilen. Professor, Agricultural and Resource Economics, University of California Davis. wilen@primal.ucdavis.edu